FACTORY-X

Factory-X

The Digital Ecosystem for Factory Outfitters and Operators

Roland Rosen, Project Manager Consortium Factory-X

PART OF MANUFACTURING-X

Supported by:
Federal Ministry for Economic Affairs and Energy
on the basis of a decision by the German Bundestag
Funded by the European Union
NextGenerationEU

Factory-X

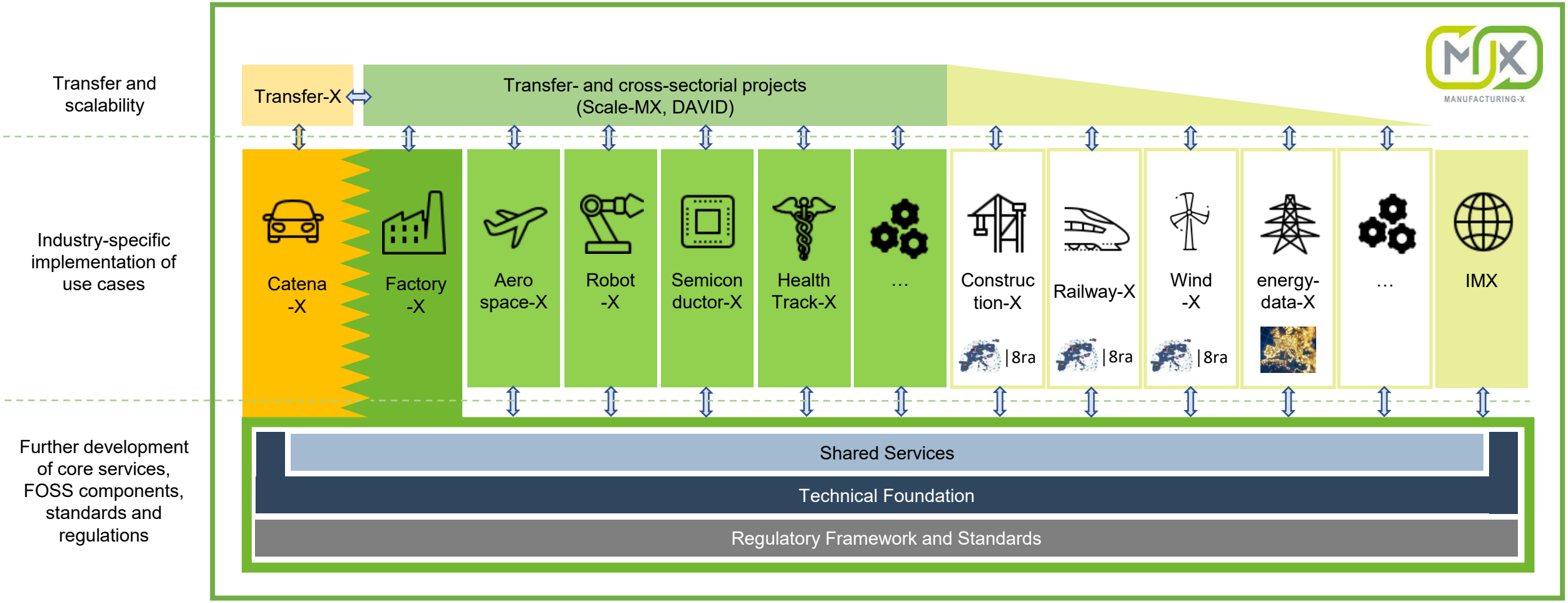
Building up data spaces with MX-Ports

International Manufacturing-X (IM-X): Make Data Work

IM-X will implement a federated, decentralized and collaborative data ecosystem for smart manufacturing. Open, global and cross-industry, following FAIR Data Principles.

Reorganize and increase flexibility and autonomy of industrial value chains and networks.	**Resilience**
Increase efficiency and enable data-driven solutions for GHG/CO2 balancing and circular economy.	**Sustainability**
Accelerate digital innovations and enable new data-driven business models to create new value for manufacturing	**Competitiveness**

Germany
Cooperation between the projects



All icons by icons8

The Factory-X Consortium

Industrial Partners

ARVATO SYSTEMS
BASF We create chemistry
Berger
codewerk
DMG MORI
Empolis
ePLAN
FESTO
GEC
hilscher
ifm
igus
inovex
InstaWerk
Lenze engineered to win
matchory
mt ANALYTICS
OPEN INDUSTRY 4.0 ALLIANCE
PAKIC
PHOENIX CONTACT
prenode
Proalpha
RIF Engineering & Consulting
SAP
Scheer
SCHUNK
sdfs
SICK Sensor Intelligence.
SIEMENS
soffico
software AG
TRUMPF
T Systems
TÜV SÜD
UHLMANN GROUP BEYOND PACKAGING
WITTENSTEIN

Associations & Research Partners

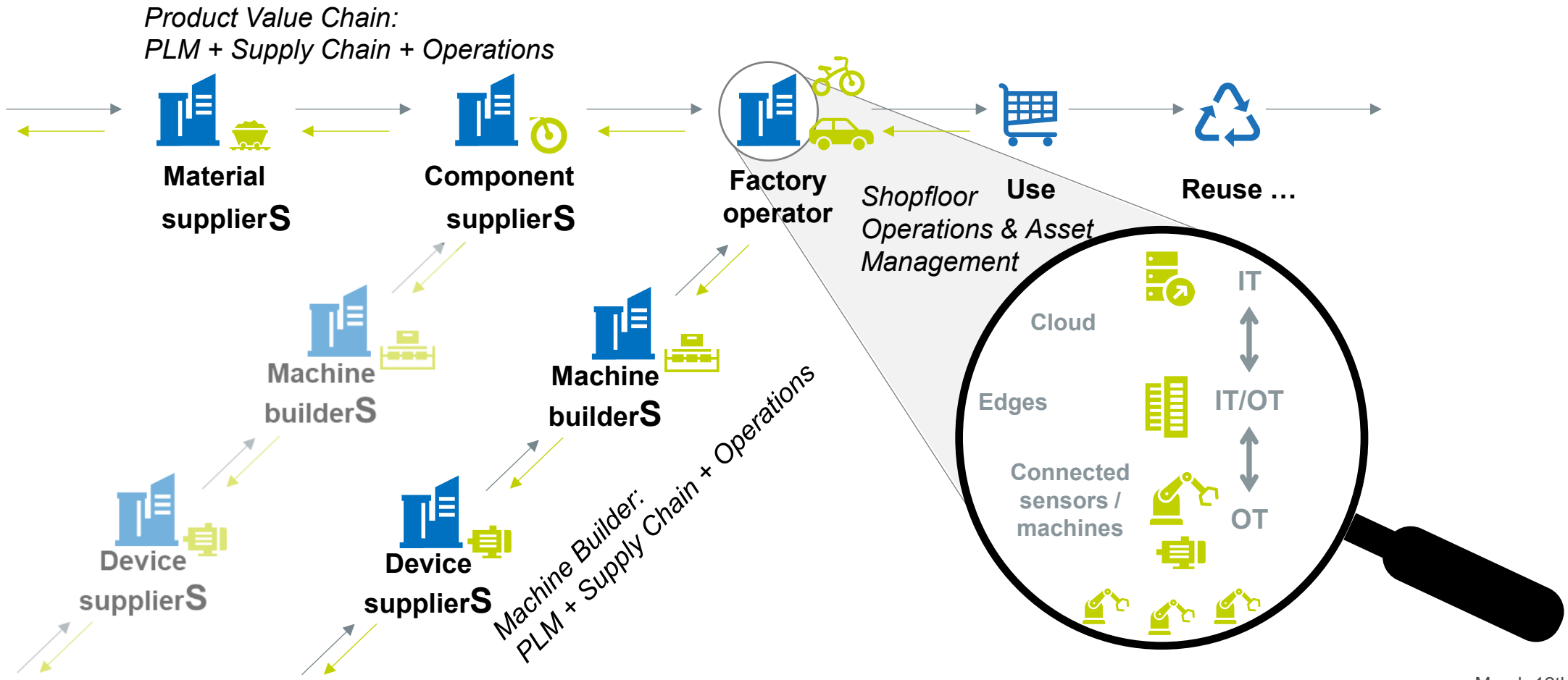
August-Wilhelm Scheer Institut Digital Research
Fraunhofer
IFW Institut für Fertigungstechnik und Werkzeugmaschinen
ISW
RUHR UNIVERSITÄT BOCHUM RUB
smartFactory
Catena-X
ESTAINIUM Association
LNI4.0
VDMA
zvei electrifying ideas

Associated Partners

ARENA2036
bayern innovativ Innovation leben
BECKHOFF
BOSCH
Digital Data Chain Consortium
EVIDEN
IDTA
Sharecat
STANDARDIZATION COUNCIL INDUSTRIE 4.0
zvei electrifying ideas

Factory-X
Our Scope and claim

Building the foundation of an open and collaborative digital ecosystem for factory outfitters and operators!



11 Use Cases of Factory-X

11 Use Cases for horizontal and vertical data transfer

Integrated Toolchains and Collaborative Engineering

Information Update and Change Service

Collaborative Information Logistics

Condition Monitoring led Services

Modular Production

Manufacturing as a Service - On Demand Manufacturing

Autonomous Operation-as-a-Service

Traceability

Energy-Consumption and Load Management

Carbon Footprint Management

Circular Economy

Factory-X Kernel & Basis Services

11 Use Cases of Factory-X

11 Use Cases for horizontal and vertical data transfer

Integrated Toolchains and Collaborative Engineering
engineering of a product

Information Update and Change Service
optimization of operations

Collaborative Information Logistics
optimization of operations

Condition Monitoring led Services
optimization of operations

Modular Production
optimization of operations

Manufacturing as a Service - On-Demand Manufacturing
optimization of operations

Autonomous Operation-as-a-service
optimization of operations

Traceability
optimization of supply chain

Energy-Consumption and Load Management
optimization of operations

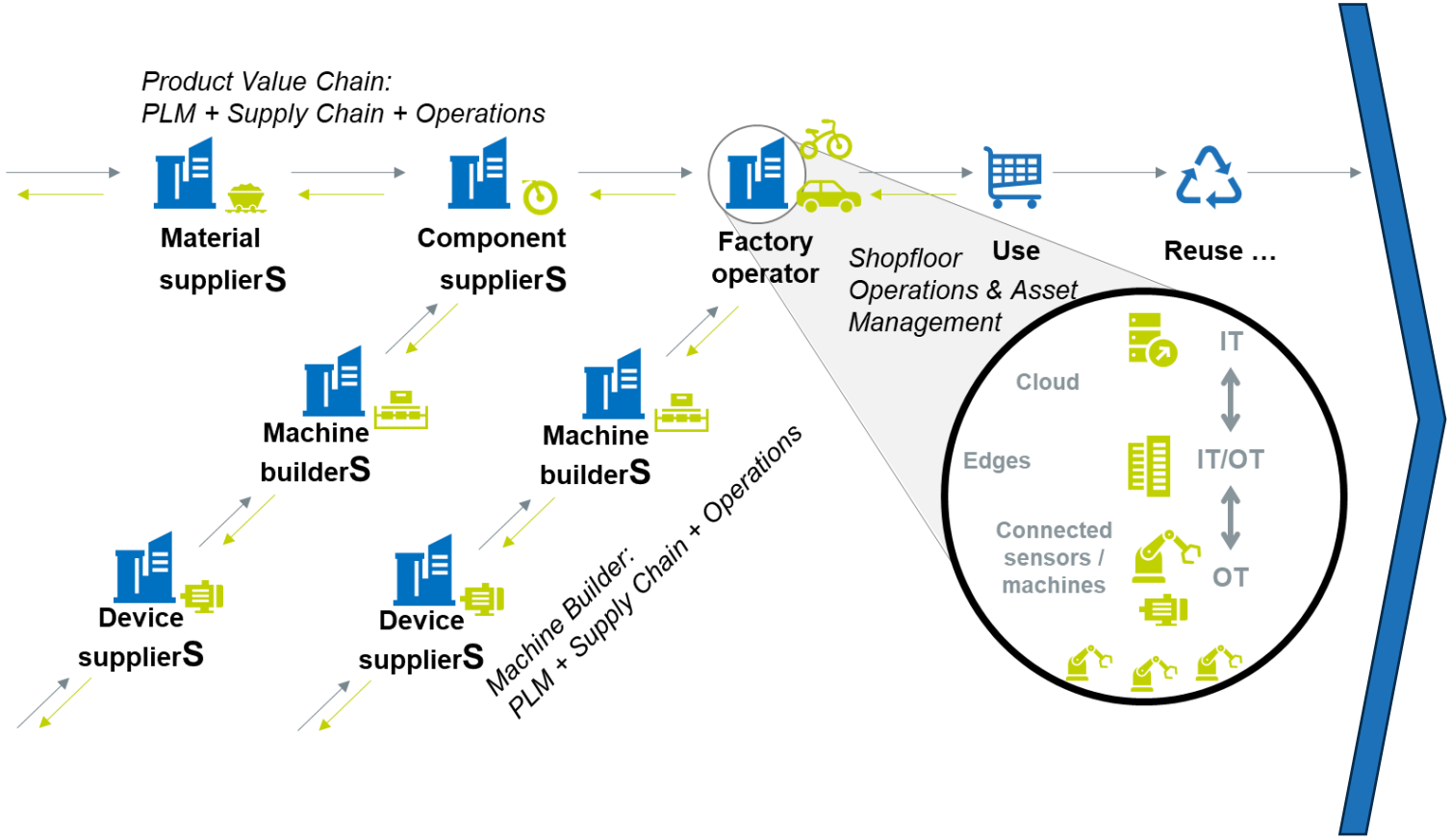
Carbon Footprint Management
optimization of supply chain

Circular Economy
assessment of remaining life

Factory-X Kernel & Basis Services

“One size fits all” does not work. We need a modular approach to achieve interoperable data spaces

The Factory-X Continuum



Generic structure of MX-Port

- Layered structure with different functional manifestations per layer
- Use case can configure specific MX-Port according to its needs

MX-Port Layer	Components for configurations
MX Discovery	A1 A2
MX Access & Usage Ctrl.	B1 B2
MX Gate	C1 C2
MX Converter	D1 D2 D3
MX Adapter	application specific

options

“One size fits all” does not work. We need a modular approach to achieve interoperable data spaces

Layer	Purpose
MX Discovery	. . . is used to find business partners, data assets (e.g. devices) or business applications.
MX Access & Usage Ctrl.	. . . is used to ensure that data providers can define the data access and usage as well as restrict the access and usage of the provided data.
MX Gate	. . . is used to exchange data in a uniform way.
MX Converter	. . . provides the semantic model for the data to be exchanged.
MX Adapter	. . . enables any business application to use the MX-Port.

Generic structure of MX-Port

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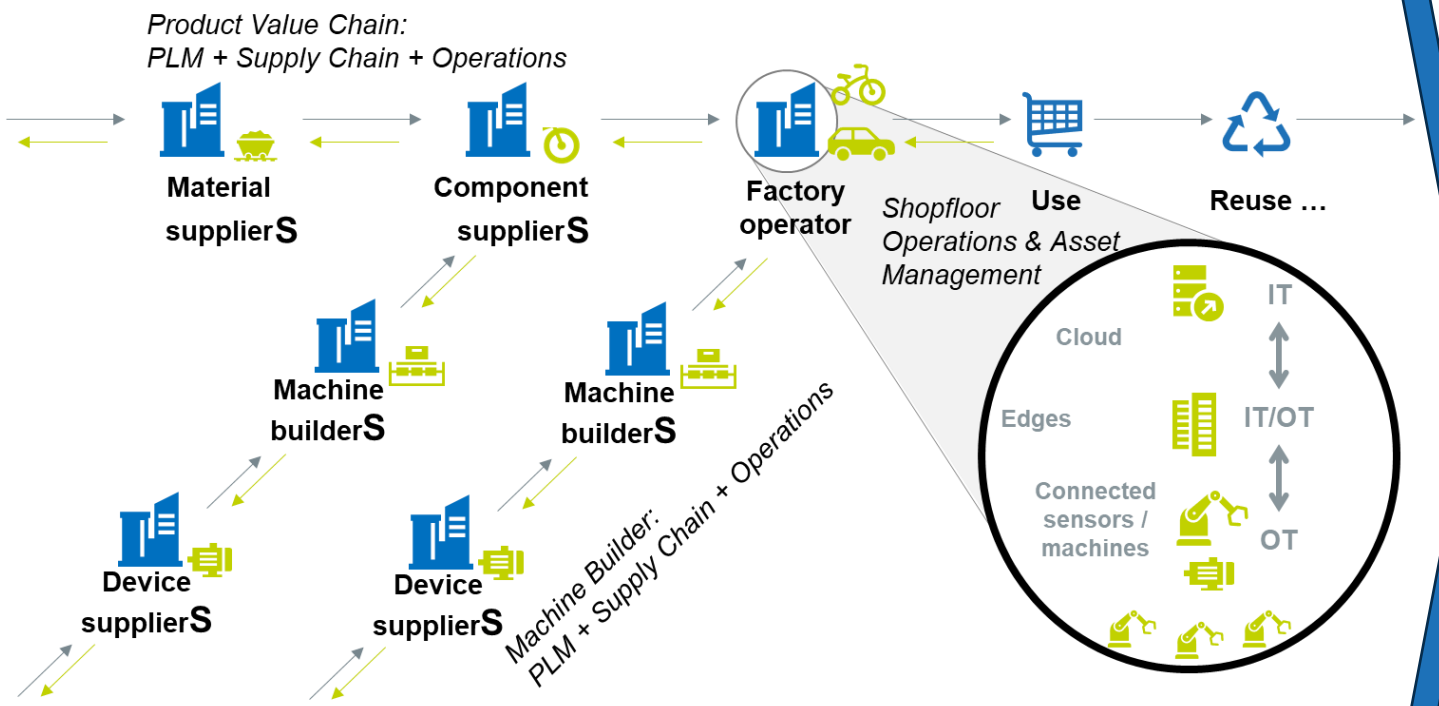


Foci of MX-Port Configurations

Supply Chain oriented

“HERCULES”

PLM +
Operations Mgmt. for Production Equipment

“LEO”

Operations Mgmt. for Production Equipment

“ORION”

Using the MX-Port concept, Factory-X realizes the following MX-Port configurations

Configuration “Hercules”

- Using DSP/DCP for cross-company data sharing

layer	MX-Port “Hercules”
MX Discovery	Dataspace Protocol
MX Access & Usage Ctrl.	Decentralized Claims Protocol
MX Gate	HTTPS (like AAS) / MQTT (like OPC UA) / BlobStorage
MX Converter	AAS Submodels / AAS Events / …
MX Adapter	application specific

Configuration “Orion”

- OPC compliant; synchronous/asynchronous cross-company data sharing

layer	MX-Port “Orion”
MX Discovery	Dataspace Protocol
MX Access & Usage Ctrl.	Decentralized Claims Protocol (OPC UA Security)
MX Gate	OPC UA Binary / OPC UA MQTT (JSON)
MX Converter	OPC UA Information Model (w. Companion Spec.)
MX Adapter	application specific

Configuration “Leo”

- IEC 63278 / IDTA compliant; AAS as integration technology for cross-company data sharing

layer	MX-Port “Leo
MX Discovery	Company Lookup / ID-Link
MX Access & Usage Ctrl.	Trusted Partner List / AAS Security
MX Gate	AAS-REST / AAS-MQTT
MX Converter	AAS Submodels
MX Adapter	application specific

MX-Port Leo: Think Big, Start Small, Scale Up!*

Immediate entry possible for data providers and data consumers

- A data provider only needs to provide an AAS server in accordance with IDTA / IEC 63278
- No further requirements need to be met to provide data
- Data consumer can access data in accordance with IDTA / IEC 63278

Operation possible without 3rd party operating company

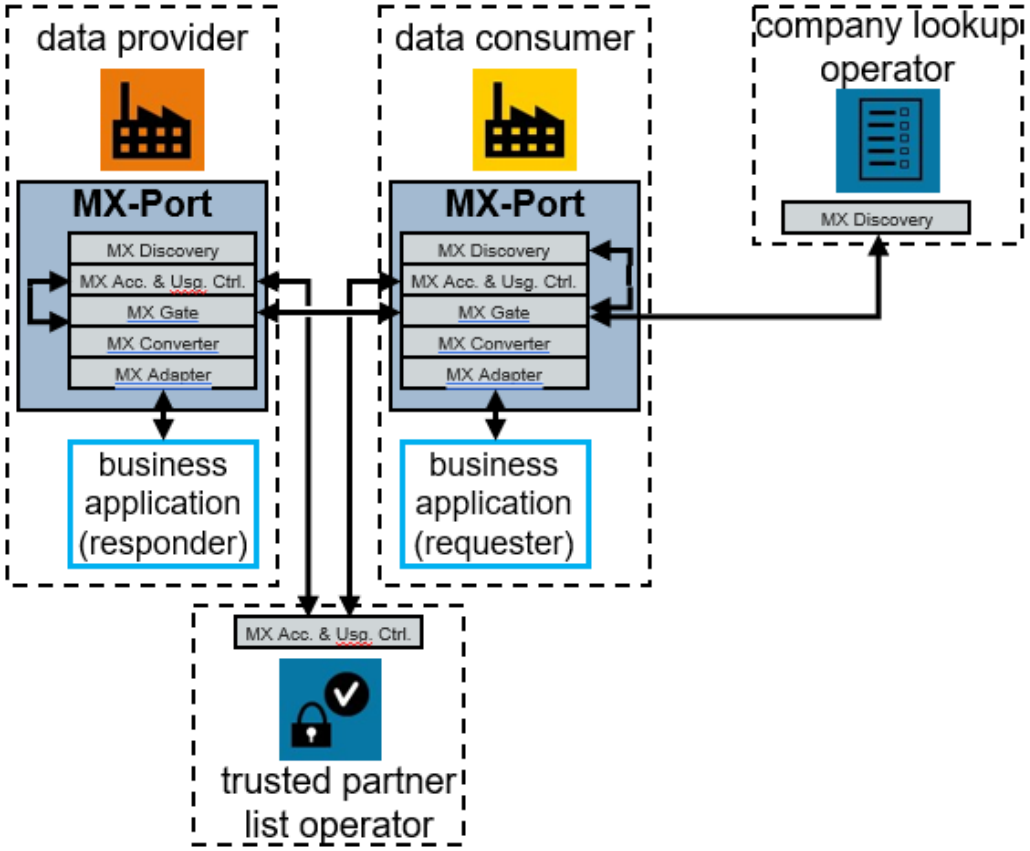
- Neither a data provider nor a data consumer needs to register at any 3rd party

Each company operates its own system to manage its identities

- Identities currently managed by a company do not need to be duplicated
- Identities extend down to the device/service and user level, not just the company level

Scalable regarding many partners for data exchange

- Gradually expandable following to business needs and opportunities of a company



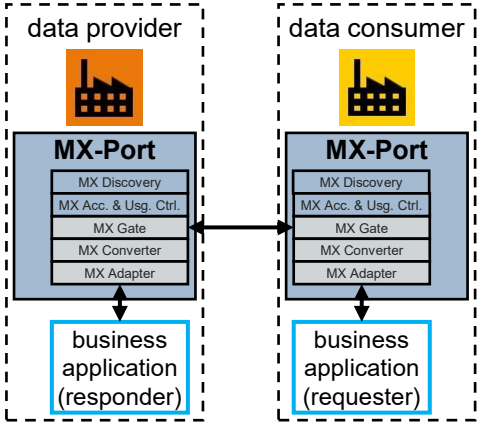
*) Asset Administration Shell – Quick Start Guide

MX-Port configuration “Leo” paves the way for companies to be able to share data with many partners in the future

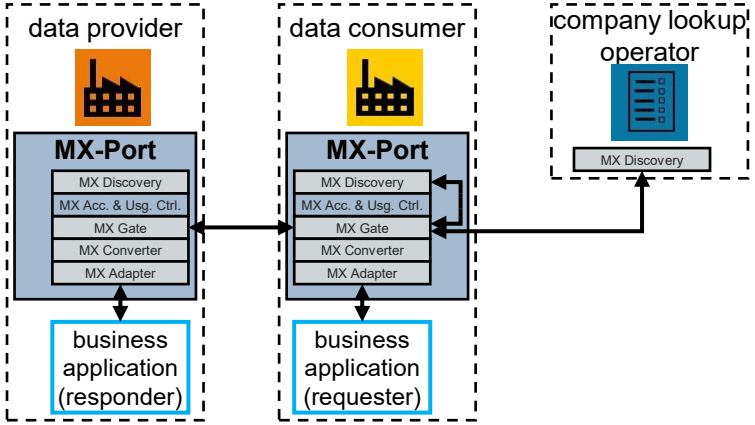
building on each other

building on each other

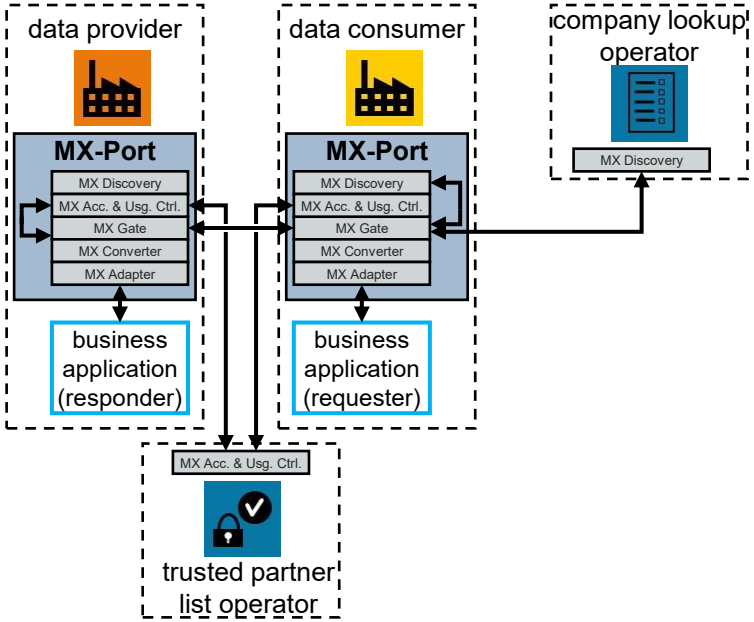
Step 1: standardized common data models and data access



Step 2: standardized discovery of the data provider



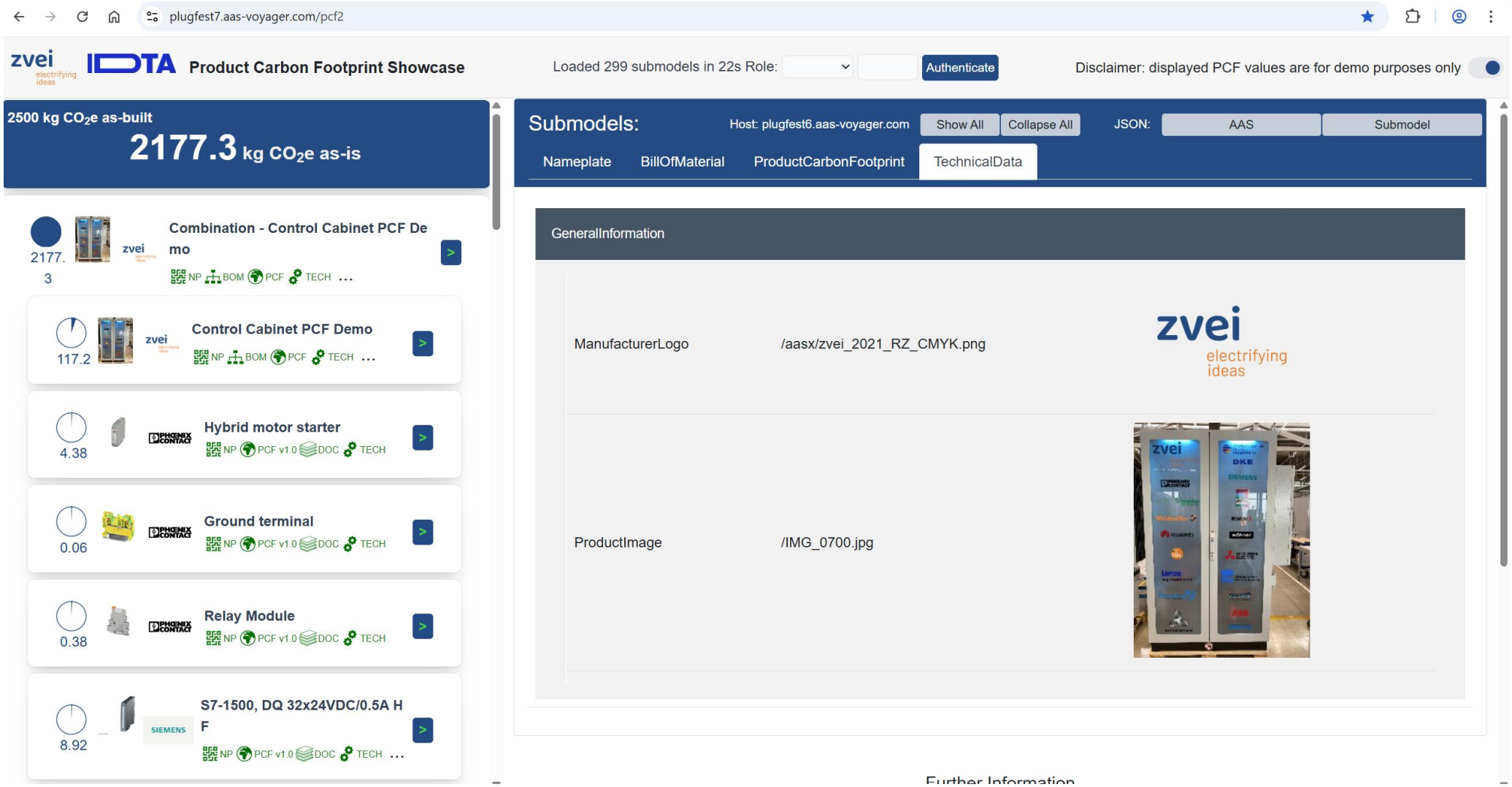
Step 3: standardized concepts for data sovereignty and trust



MX-Port configuration
“Leo”

Note: Step 2 (additional discovery options) and Step 3 (additional security options) can be swapped

MX-Port Leo: Integration of Discovery and Security in ZVEI PCF Showcase (Internal Hackathon)



Digital Data Chain Consortium*

Digitalisierung ermöglicht effiziente Prozesse

…aber nur

Beis

Wo ste

1 30.9.2025

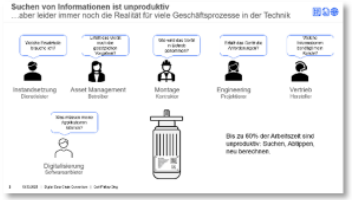
Die Digital Data Chain ermöglicht einen vereinfachten Informationsaustausch

Sie bringt ein

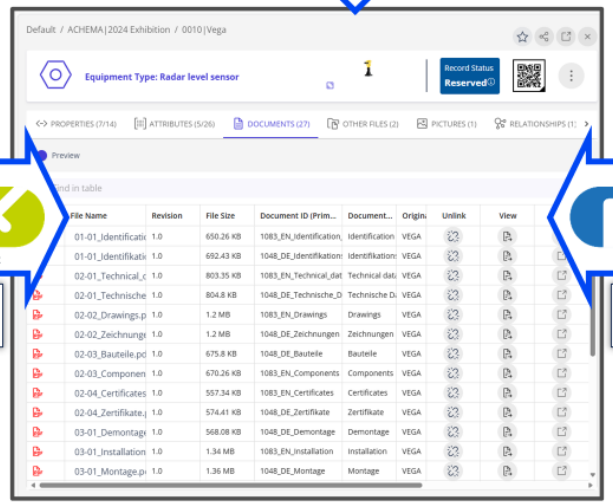
2 30.9.2025 | Digital D

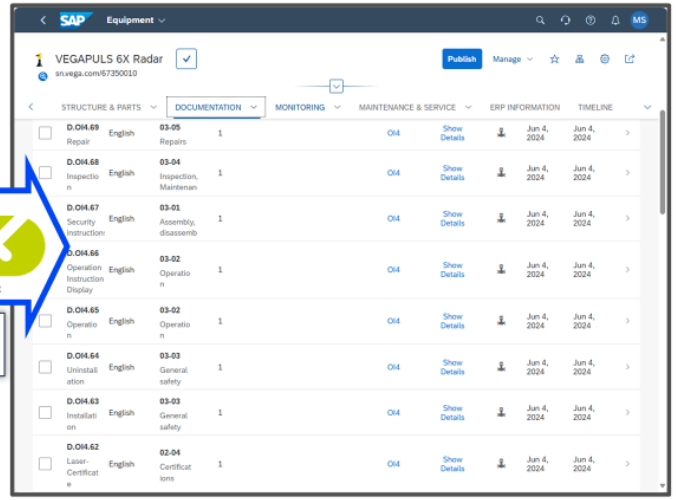
Von der Digitalen Datenkette zum Datenraum: Factory-X

Manufacturing-X ermöglicht den interoperablen Austausch zwischen Firmen und Applikationen



- Factory-X liefert die Grundlagen für den firmen- und applikationsübergreifenden Austausch.
- Handover Documentation ist ein wichtiges Beispiel → EU DPP
- Aufbau einer Digital Twin Verbindung zwischen Firmen birgt ein großes Potenzial → Software-Update, Prüfzyklen, Abkündigungen, Ersatzteile, etc.



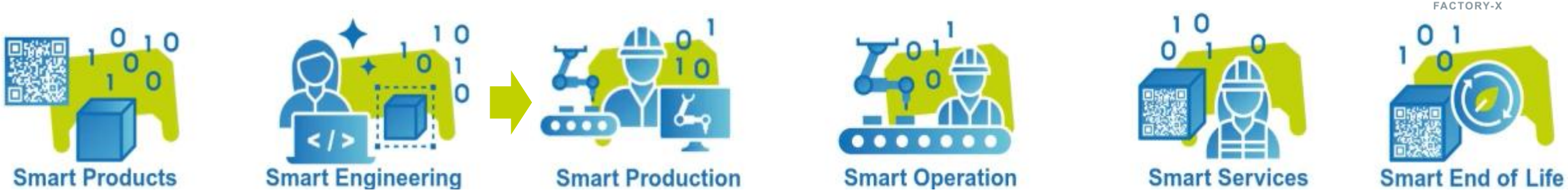


FACTORY-X: The digital ecosystem

4 30.9.2025 | Digital Data Chain Consortium | Dr. Carl-Philipp Ding

* Acknowledgements:
We would like to thank Attila Kun and Carl-Philipp Ding (both BASF) for providing the slides.

Engineering and Manufacturing of Electrical Systems
Value Added of AAS-based Data Exchange in Product Life Cycle



as-is

- **Time consuming processes**
  - searching for component details
  - searching for 3D-macros
- **Time consuming data transfer**
  - transfer from electrical drawing to layout planning
  - transfer from drawings to configuration software of component suppliers
  - transfer from IT-systems to machines
  - transfer of data to blue collar workers

to-be with Factory-X

- **Data runs seamlessly** between systems in house and from suppliers, based on AAS and MX-Port technologies
- **Easy to integrate configuration software** based on AAS and MX-Port technologies
- Huge **rise in productivity** by eliminating wasted time for searching and transferring

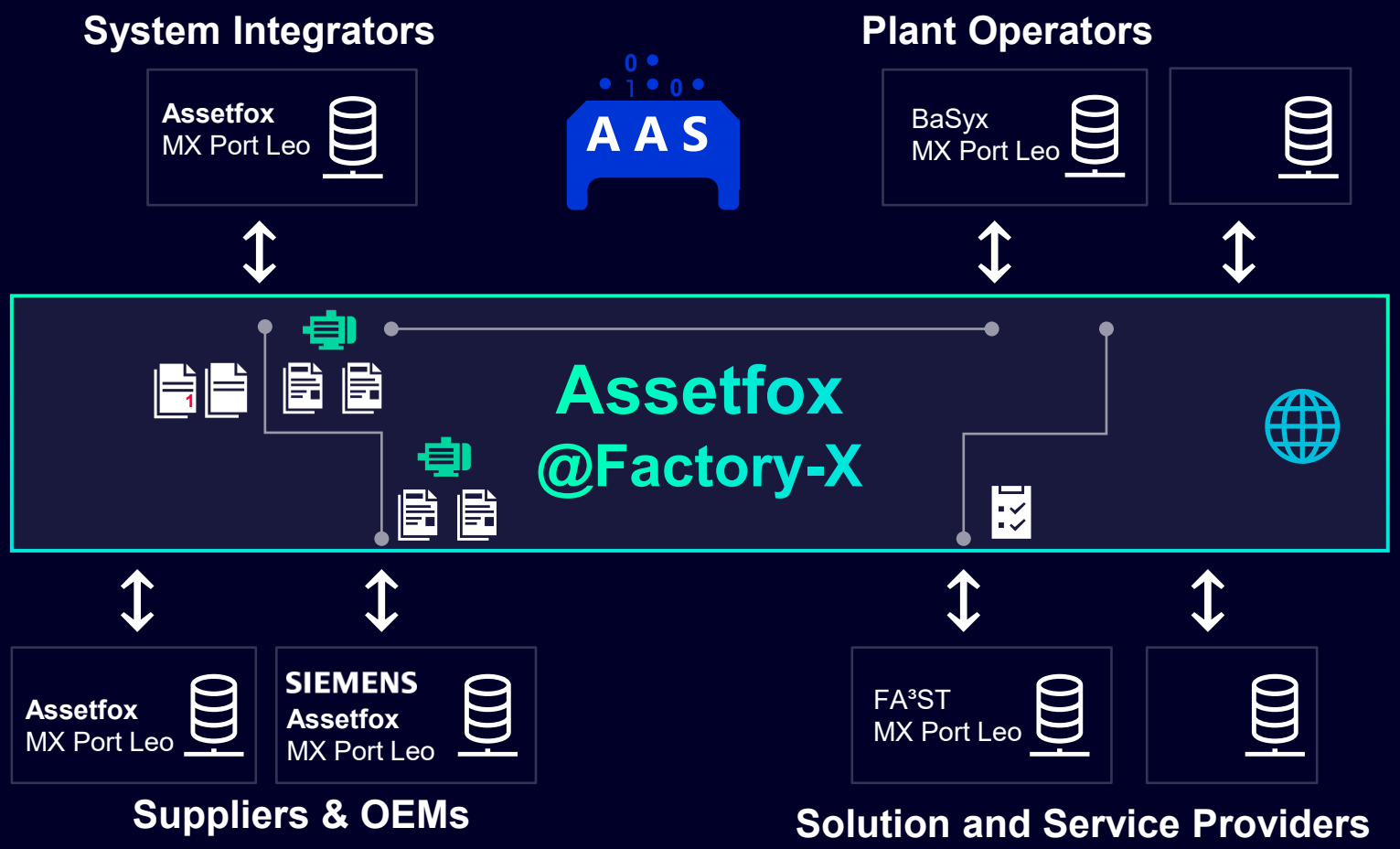
Automated access to functional data, e.g. circuit diagram, via AAS

Siemens Assetfox

AAS based Data Exchange Solution implementing MX Port Leo

Goals

- Empowers industrial companies to access up-to-date asset information
- Provides easy, seamless and efficient information exchange
- As a Service implementation of MX Port Leo (MX Port Hercules soon)
- Standardization of information exchange following
  - VDI2770
  - IEC 61406 ID Link
  - IEC 63278 Asset Administration Shell (AAS)
  - ECLASS



 Unrestricted | © Siemens 2026

SIEMENS

MX-Port Leo: Summary / Key Aspects

- “Start small”: AAS as starting point – MX-Port Leo integrates in today’s setups for (inter-company) data exchange
- “Scale up”: additional options (“Steps”) for discovery and security as needed – well integrating into existing AAS architectures

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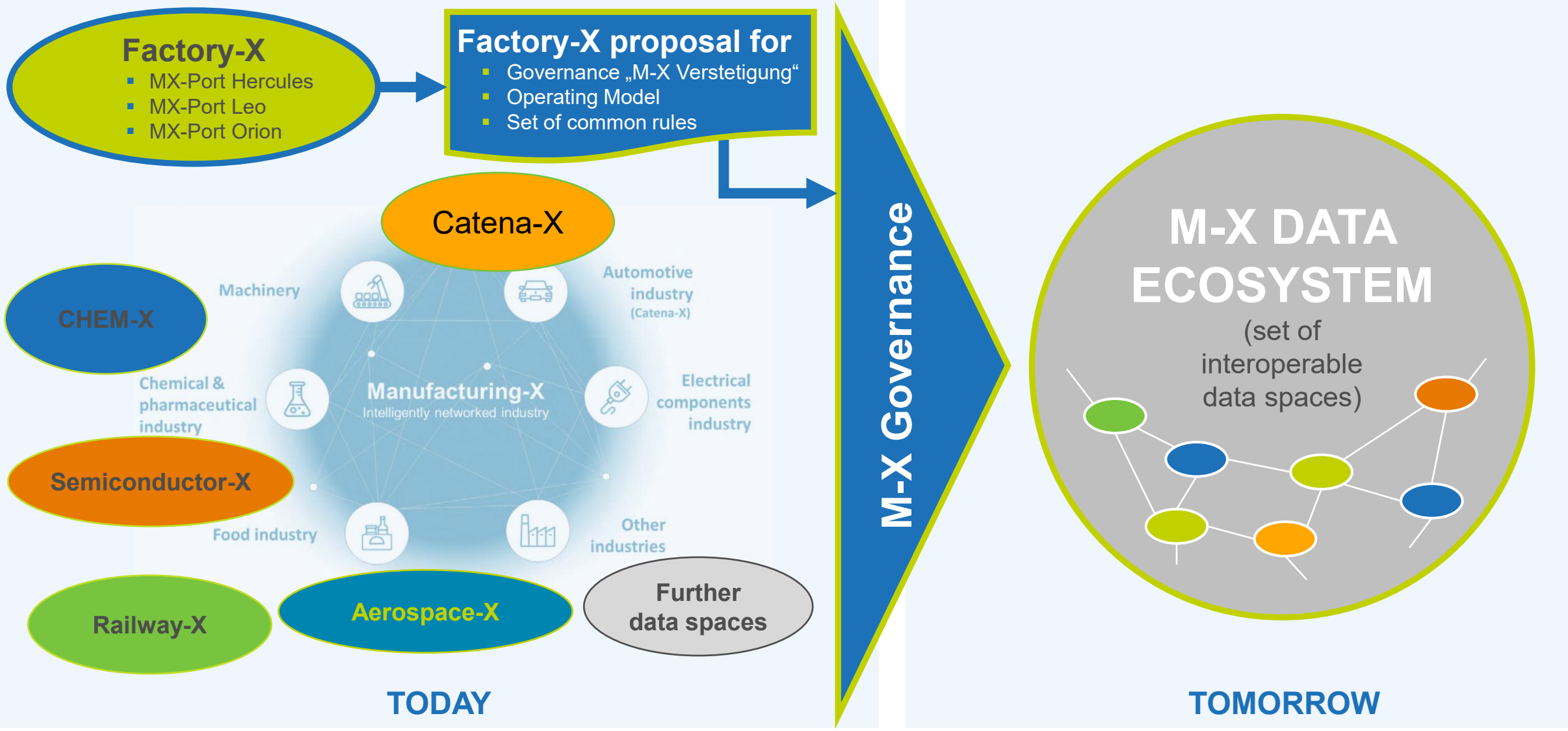
- **Discovery**: two services for finding business partners: **Company Lookup**, **Yellow Pages**
- **Identity**: no new identities issued – Data Provider & Data Consumer use their available identities
- **Authentication**: based on **F-X Token** and light-weight **Trusted Partner List**
- **Authorization**: using available mechanisms in AAS Registry and AAS Repository based on AAS Security (IDTA-01004)
- **Usage Control**: description of usage policies associated with provided data supported
- **Operation**: central and decentral operation of Leo’s discovery (Company Lookup) and security (Trusted Partner List) possible

Low entry barrier, but individually and gradually expandable

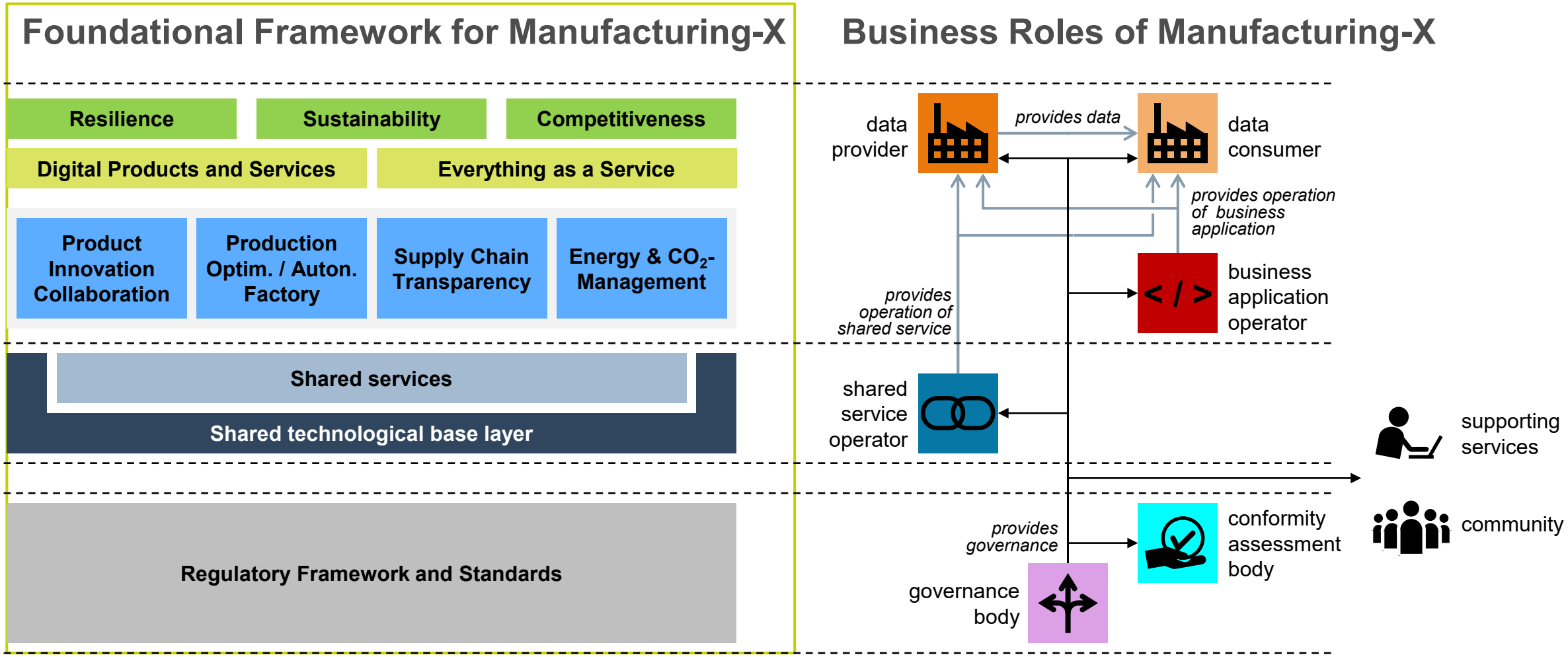
Way forward to M-X DATA ECOSYSTEM



Thank you

Contact information:

info@factory-x.org
www.factory-x.org

Backup

Scope of Business Roles in Relation to the Foundational Framework for Manufacturing-X